Rock Creek Water Quality Monitoring Report

Power County, Idaho

Developed for:

Power Soil Conservation District
Lake Walcott Watershed Advisory Group

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Districts

Technical Results Summary #3

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By Mark Dallon

Idaho Association of Soil Conservation Districts
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Executive Summary

Rock Creek is a tributary of the Snake River in southeastern Idaho, draining 320 square miles of parts of Power, Cassia and Oneida Counties. Rock Creek begins at the confluence of the South Fork and East Fork of Rock Creek in the town of Rockland. Rockland Valley is 10 miles wide and 25 miles long, bordered by the Sublett Range on the west and Deep Creek Range on the east. Livestock grazing and dryland agriculture are main land uses, with a small amount of irrigated agriculture along Rock Creek in the valley bottom. Rock Creek, the South Fork and the East Fork are all included on the state of Idaho 303(d) list of impaired water bodies and a Total Maximum Daily Load (TMDL) has been written for each of them. The TMDL set limits on concentrations of total suspended sediment (TSS) for each segment at a monthly maximum of 50 mg/L or a one-time measurement of 80 mg/L.

The Idaho Association of Soil Conservation Districts (IASCD) collected water quality samples on Rock Creek, the South Fork of Rock Creek and the East Fork of Rock Creek from July 1999 through July 2000. Under the direction of the Power Soil Conservation District (Power SCD), samples and measurements were taken for a variety of parameters including total suspended solids (TSS), *E. coli* bacteria concentrations and stream discharge. Samples were collected twice per month (once per month from Nov – Jan) at seven monitoring sites throughout Rockland Valley.

The East Fork of Rock Creek showed significant increases in TSS from its spring source 6 miles east of Rockland. From a TSS concentration of virtually zero at its source, average concentration at the confluence with the South Fork was 58 mg/L and 8 of 13 months had averages above the 50 mg/L standard. Concentrations above the standard occurred throughout the year, indicating there are several probable sources of sediment in the East Fork. Poor irrigation management and resultant return flows were an obvious source of sediment to the East Fork during the irrigation season. Stream bank erosion and the reworking of sediment deposited in the channel by upland erosion resulted in high TSS values during the winter, when stream discharge was at its maximum.

Three of the four sites on the South Fork of Rock Creek were above the monthly TSS standards from November through March and the site on Rock Creek exceeded standards from September through April. Only one site on the South Fork was above the standard regularly during the irrigation season. TSS levels in Rock Creek and the South Fork increase as stream discharge rises in the fall. Stream bank erosion and upland erosion are the major concerns for water quality on Rock Creek and the South Fork.

Planning for agricultural best management practices (BMPs) on all stream segments in the Rockland Valley should emphasize improvements in dryland agricultural field soil conditions during late winter and late summer when runoff events are most common. BMPs should also focus on increasing riparian vegetation to reduce stream bank erosion. In addition, BMPs on the East Fork of Rock Creek should focus on improvements in diversion structures and irrigation management to improve the quality of water returning to the creek from ditches and field runoff.

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Introduction

The Rock Creek watershed is located in southeastern Idaho in hydrologic unit code (HUC) 17040209, also referred to as the Lake Walcott HUC. The Rock Creek watershed includes parts of Power, Oneida and Cassia Counties. Rock Creek is a tributary of the Snake River and empties into the river approximately 12 miles downstream of American Falls Dam. At the request of the Power Soil Conservation District (Power SCD), the Idaho Association of Soil Conservation Districts (IASCD) collected water quality data on Rock Creek, South Fork Rock Creek and East Fork Rock Creek from July 1999 through July 2000. The project was implemented to provide the Power SCD and other groups information on agricultural pollutants in Rock Creek. Other groups include the United States Department of Agriculture Local Working Group for Power County, the Lake Walcott Watershed Advisory Group (WAG) and the Idaho Soil Conservation Commission (SCC).

Three segments of Rock Creek are included on the State of Idaho 303(d) list of impaired water bodies. A Total Maximum Daily Load (TMDL) analysis for the Lake Walcott HUC has been written by the state of Idaho Department of Environmental Quality (DEQ) and approved by the Environmental Protection Agency (EPA) (Lay 1999). Sediment was the only limiting water quality parameter identified on the 1998 303(d) list in Rock Creek and its tributaries. The purpose of this monitoring project was to identify patterns of high sediment levels and to identify potential sources of sediment and methods of sediment transport to the stream channel.

Rock Creek and the Rockland Valley

Rock Creek enters the Snake River 12 miles downstream from American Falls Dam and originates at the confluence of the East Fork and South Fork within the town of Rockland. The confluence is approximately 13 miles upstream of the Snake River. East Fork Rock Creek begins at a series of springs at the base of the Deep Creek Mountains six miles east of Rockland. It flows west and meets the South Fork, which originates in the Sublett Range 20 miles south of Rockland. The upper section of the South Fork is intermittent and the channel only has perennial flow below a series of springs 11 miles south of Rockland. It runs down the center of Rockland Valley northward to its confluence with the East Fork. Below the confluence of the East and South Forks, Rock Creek flows northwest and enters the Snake River near Register Rock (Figure 1).

Rockland Valley is approximately 8-10 miles wide and 25 miles long, draining from south to north. The valley is bordered on the east by the Deep Creek Mountains and on the west by the Sublett Range. The mountains rise approximately 3000 feet above the valley floor and receive considerably more precipitation than the valley. The geology of the Deep Creek Mountains and the Sublett Range is predominantly permeable carbonate rock and there is very little surface runoff from the mountains to Rockland Valley. Flow in Rock Creek is primarily from springs located at the base of the Deep Creek Mountains and along the valley floor where the infiltrated water emerges.

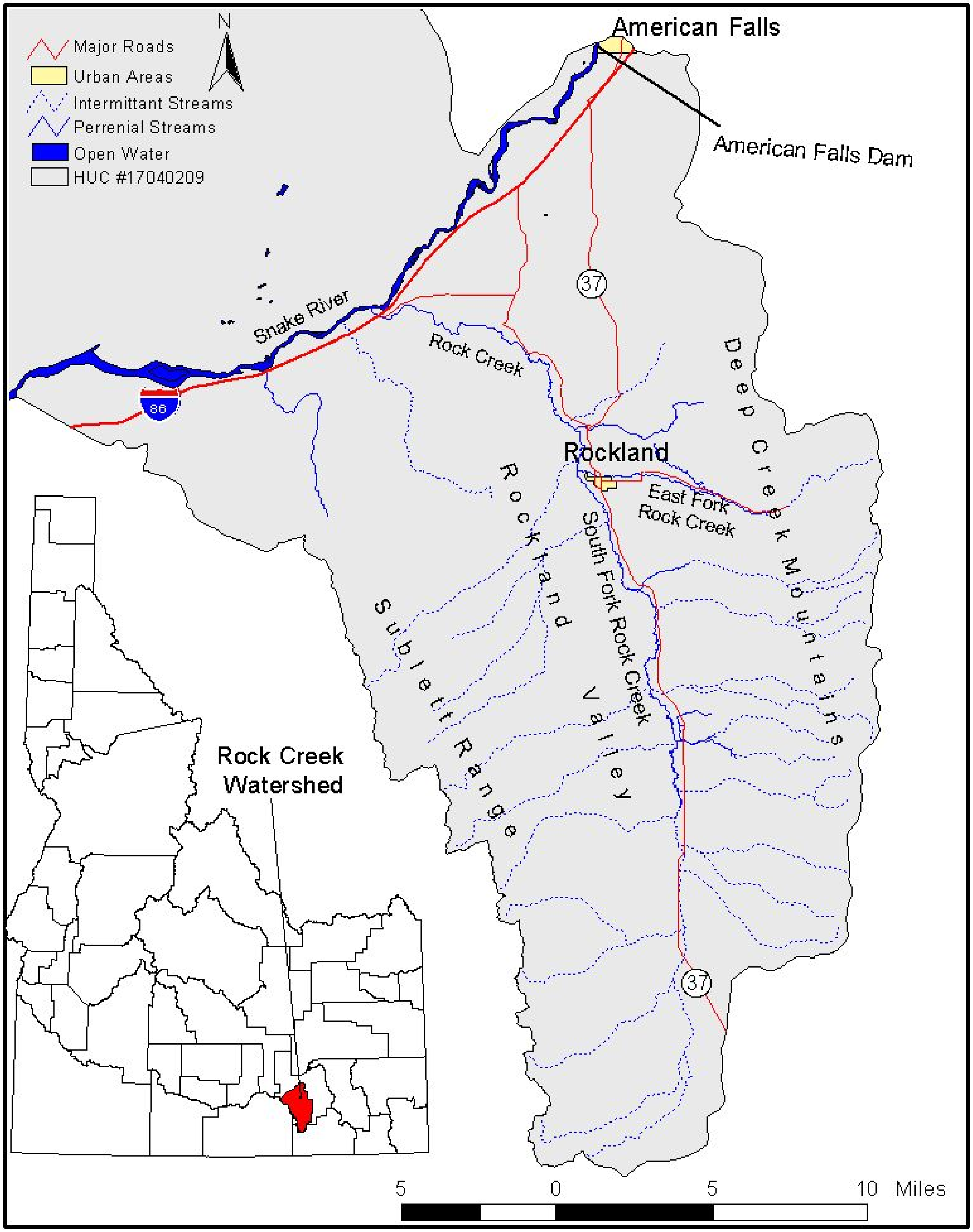

Figure 1. Rockland Valley

Land use in the Rockland Valley is primarily grazing, dryland agriculture and limited irrigated agriculture. Irrigated agriculture is concentrated along the valley bottom and is the major land use along Rock Creek itself. Dryland farms occupy the majority of the valley and there are extensive areas formerly managed for dryland agriculture that have been placed under the Conservation Reserve Program (CRP) and are not currently farmed. Approximately 70% of the area formerly in dryland agriculture is currently in CRP (Roy Fowler 2001).

Precipitation in Rockland Valley averages approximately 14 inches annually (University of Idaho 1995). The Deep Creek Mountains and the Sublett Range bordering the valley receive between 20 and 30 inches annually, values increasing with elevation. The estimated average rainfall over the entire Rock Creek drainage is 17.3 inches annually (Williams and Young 1982). Although there is no weather station in Rockland Valley, two stations exist nearby at Massacre Rock State Park (near the mouth of Rock Creek) and at Arbon (in Arbon Valley just east of Rockland Valley). Data from those two stations showed that from July 1999 through July 2000 (inclusive), precipitation was between 48% of normal (Arbon) and 56% of normal (Massacre Rocks State Park) (ISCC 2002). Precipitation for the 13-month period totaled approximately 7 inches at each weather station.

Rock Creek and The Lake Walcott TMDL

A Total Maximum Daily Load (TMDL) has been developed for the Snake River and its tributaries between American Falls Dam and Milner Dam. Tributaries included on the state of Idaho 303(d) list are specifically addressed in the Lake Walcott TMDL, including Rock Creek, South Fork Rock Creek and East Fork Rock Creek.

The TMDL has set concentration standards for total suspended sediment (TSS) on all three stream segments in Rockland Valley. Concentrations of TSS are to be no greater than 50 mg/L as a monthly average and 80 mg/L for any one measurement (Lay 1999). Idaho standards apply for concentrations of E. coli bacteria in all state waters where recreation is listed as a beneficial use, including Rock Creek, East Fork Rock Creek and South Fork Rock Creek. The standard for *E. Coli* sets trigger values at 406 colonies per 100 mL (cfu) for water bodies where primary contact recreation (PCR) is listed as a beneficial use and 576 cfu for secondary contact recreation (SCR). Any measurement over that value requires that four additional samples be taken within 30 days. The geometric mean of the five samples should not exceed 126 cfu (IDAPA 58.01.02). Applicable TMDL and state standards are listed in Table 1.

Table 1. Lake Walcott TMDL and State of Idaho Water Quality Standards

Pollutant	TMDL or State of Idaho Standard
Total Suspended Sediment	• 50 mg/L monthly average maximum • 80 mg/L daily average maximum
Eschericia Coli	• One-time value of 406 cfu or greater (PCR) requires 5 samples over 30-day period geometric mean of 126 cfu • One-time trigger value of 576 cfu (SCR) or 5 samples over 30-day period geometric mean of 126 cfu

Project Objectives

The objectives for this monitoring project were outlined in July of 1999 before monitoring began (Dallon, 1999). Meetings were held with the Power SCD and the District Conservationist of the Natural Resources Conservation Service (NRCS) in American Falls to determine what the goals of the monitoring would be. The objectives were included in the project plan written in July of 1999. The objectives were to:

- Assess existing water quality conditions and impacts from agricultural activities.
- Establish photo points to document stream corridor condition over time.
- Identify areas of concern for implementation of best management practices by local agencies and groups.
- Identify and characterize major agricultural nonpoint pollution sources that degrade water quality.
- Use the data for public awareness.

Monitoring Site Locations

Seven monitoring sites were originally selected for this project. One site was added midway through the project at the mouth of Rock Creek, although data from that site is of limited use. The sites were selected based on their location in relation to tributaries, access points and relative distance from one another. The sites are numbered upstream beginning at the mouth of Rock Creek at the Snake River. Descriptions of the locations are listed in Table 2 and a map of the sites is included in Figure 2.

Table 2. Monitoring Site Descriptions

Site	Description
RC0	Rock Creek at Register Rock, 50 meters above mouth to Snake River.
RC1	Rock Creek at Roper Lane, 5 ½ miles above mouth.
EF1	East Fork at Rockland; ¼ mile above confluence with South Fork
EF2	East Fork below spring source, 6 miles east of Rockland.
SF1	S Fk Rock Creek at Rockland; ¼ mile above confluence with East Fork.
SF2	S Fk Rock Creek 4 miles south of Rockland, just below Sand Hollow.
SF3	S Fk Rock Creek at Flint Canyon Road.
SF4	S Fk Rock Creek at Simms Road.

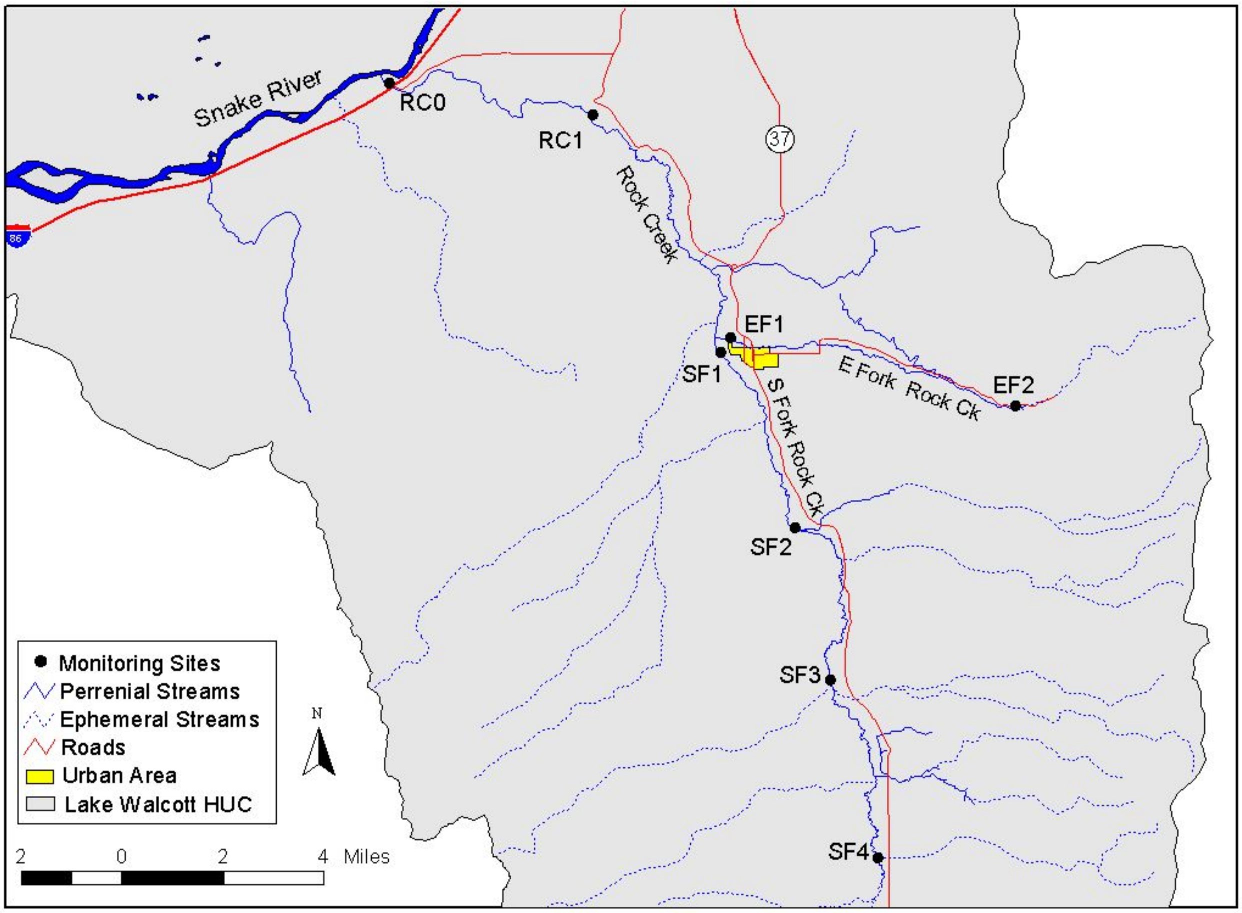

Figure 2. Monitoring Site Locations

Methods

Sampling Schedule and Parameters

Data was collected twice a month except during November, December and January, when only one sample per month was taken. Sampling began July 20, 1999 and ended July 31, 2000. Twenty-two sampling events were made at all sites except RC0, which was added in March of 2000 and was sampled a total of nine times.

Samples were collected and measurements taken for the parameters listed in Table 3. Approved Environmental Protection Agency (EPA) laboratory methods used for lab analysis and instruments used for field measurements are listed.

Sampling Methods

Sample collection techniques followed approved United State Geological Survey (USGS) methods (Shelton, 1994). All analytical testing followed either EPA or Standard Methods for the Examination of Water and Wastewater (SM) approved methods. Quality Control samples (duplicates and blanks) comprised at least 10 % of the sample load during this program. Quality Assurance and Quality Control (QA/QC) results are in Appendix A. Duplicate and blank samples were stored and shipped with the normal sample load for analytical testing. For project tracking, chain-of-custody protocols were followed for all sample handling.

Table 3. Water quality parameters and field measurements

Water Quality Parameters	**Laboratory Method**
Total suspended solids (TSS)	EPA 160.2
Total volatile solids (TVSS)	EPA 160.4
Total phosphorous	EPA 365.4
Orthophosphate	EPA 365.2
Nitrate	EPA 353.2
Nitrite	EPA 353.2
Ammonia	EPA 350.1
Total kjeldahl nitrogen	EPA 351.2
Fecal coliform bacteria	Standard Methods
Eschericia Coli bacteria	Standard Methods
Field Measurements	**Instrument**
Dissolved oxygen	YSI Model 55
Water temperature	YSI Model 55
Conductivity	Orion Model 115
Total dissolved solids	Orion Model 115
pH	Orion Model 210A
Stream discharge	Marsh McBirney Flo-Mate Model 2000

Flow Measurements

Flow measurements were collected with a Marsh McBirney Flo-Mate Model 2000 flow meter. The six-tenth-depth method (0.6 of the total depth below water surface) was used when the depth of water was less than or equal to three feet. A transect line was set up perpendicular to flow across the width of each creek and the mid-section method for computing cross-sectional area along with the velocity-area method was used for discharge determination. The discharge was computed by summation of the products of the partial areas (partial sections) of the flow cross-sections and the average velocities for each of those sections.

Sample Collection

Samples for water quality analysis were collected by grab sampling directly from the stream. A DH-81 integrated sampler was used at sites with water depths greater than 1 foot. For shallow sites (< 1ft) grab samples were collected by hand using a clean one-liter stainless steel container. With all methods, individual samples were collected at equal intervals across the entire width of the stream. Each discrete sample was composited in a 2.5-gallon polyethylene churn sample splitter from which samples were poured off into sample containers. Bacteriological samples were collected directly from the thalweg into sterile sample bottles.

Field Measurements

Field measurements for dissolved oxygen and water temperature were taken directly in the streams from well-mixed sections, near mid-stream at approximately mid-depth. Measurements for specific conductance, pH, and total dissolved solids were taken from sample water from the churn splitter, immediately following collection. Calibration of all field equipment was in accordance with the manufacturer specifications. All field measurements were recorded in a bound logbook along with pertinent observations about the site, including weather conditions, flow rates and personnel.

Results and Discussion

The East Fork is distinct in water quality concerns from Rock Creek and the South Fork. There are substantial differences in gradient, land use, average stream flow and seasonal fluctuation in stream flow. Rock Creek and the South Fork both flow through the bottom of Rockland Valley and have similar gradients, land use and hydrology. The East Fork flows from the base of the Deep Creek Range through a narrower valley cut through the foothills. The East Fork has a steeper gradient, higher average stream flow, lower seasonal fluctuation in stream flow and more direct impact from irrigation return flow. Therefore, results from East Fork Rock Creek will be discussed separately from Rock Creek and South Fork Rock Creek.

Overall, water quality in Rockland Valley during this project fluctuated with stream flow levels. TSS concentrations were generally highest during winter when stream flows were at their maximum. Bacteria concentrations were highest during summer when stream levels were at their minimum and water temperatures were higher. The following sections include results for stream discharge, TSS and bacteria. Samples were collected for several other parameters that have no numerical water quality standards and are not listed in the TMDL (Appendix B). Annual means for all data collected for the three major parameters are listed in Table 4. Monthly patterns and averages will be discussed in the following sections and complete tables of all data are included in Appendix B.

Table 4. Annual Mean and Median Values of 1999-2000 IASCD Water Quality Data

Monitoring Site	TSS mg/L		*E. Coli* cfu		Q cfs		n
	mean	median	mean	median	mean	median	
RC0 [a]	50	10	182	70	20.5	6.1	9
RC1	96	47.5	200	100	33.0	27.5	22
SF1	52	19.5	127	130	10.2	7.9	22
SF2	52	23.5	87	45	8.1	6.1	22
SF3	57	47.5	328	115	7.6	7.3	22
SF4	27	9	569	20	0.2	0.1	16[b]
EF1	58	51.5	116	60	21.1	18.7	22
EF2	2	<1	10	<10	24.6	24.0	22

[a] data from March –July: does not include high flows during winter

[b] 16 water samples collected, 22 flow measurements

Stream Discharge

Historical Stream Discharge Data

Stream discharge plays a large role in water quality in the Rockland Valley. Extensive historical data on flow patterns in the Rockland Valley does not exist. However, flow records were collected intermittently by the United States Geological Survey (USGS) at three stream gage stations in the Rockland Valley at various times between 1955 and 1990 (USGS, 2002). Station #13077500 was located on South Fork Rock Creek approximately 3 miles upstream of Rockland and was maintained from 1955 - 1960. Station #13077600 was on the East Fork approximately 5 miles upstream of Rockland and was maintained from 1960 – 1964 and again from 1978 – 1980. Station #13077650 at the mouth of Rock Creek was maintained from 1978-1980 and again from 1985-1990. A hydrograph created from data at each of the three stations is shown in Figure 3.

Flow records show very similar flow patterns on Rock Creek and the South Fork. Although flows are higher on Rock Creek than the South Fork, patterns of high and low flows were similar. There are three obvious characteristics of stream discharge at the mouth of Rock Creek. First, there is a consistent base flow of approximately 50 cfs (10 cfs on the South Fork). Second, flows during the summer are typically reduced to approximately 5 cfs (zero on the South Fork). Third, peak flow events occur almost exclusively during late winter (Jan-Mar) and late summer (July-Sep) and they are of very short duration. Rockland Valley is susceptible to rapid snow melt and rain-on-snow events during late winter due to its relatively low elevation. Extreme runoff events during January – March have an average duration of only 7 days and occur when soils are frozen and impermeable. Summer peak flows are of even shorter duration (2-3 days) and are the result of intense, localized thunderstorms. Due to the short duration of peak flows on Rock Creek, continuous stream flow monitoring data is much more useful than the twice-monthly data collected during this project by IASCD. Peak flows rarely last longer than a few days and entire flood events are likely to pass between measurements taken at 14-day intervals.

Data from the station on the East Fork of Rock Creek show a much more consistent flow pattern than Rock Creek or the South Fork. Large springs provide the base flow for the East Fork and have much less variation. Water diverted for irrigation is a lower fraction of total flow than the flow diverted from the South Fork. Over the four years of USGS records, flow on the East Fork never exceeded 24 cfs and never fell below 11cfs. The USGS gage, however, was located near the major springs that supply its consistent flow, near IASCD site EF2. Peak flows, when they do occur on the East Fork, are the result of runoff from ephemeral tributary canyons below the USGS gage site. In its lower three miles, the East Fork has much more variation and impact from runoff and begins to resemble the South Fork in appearance and water quality.

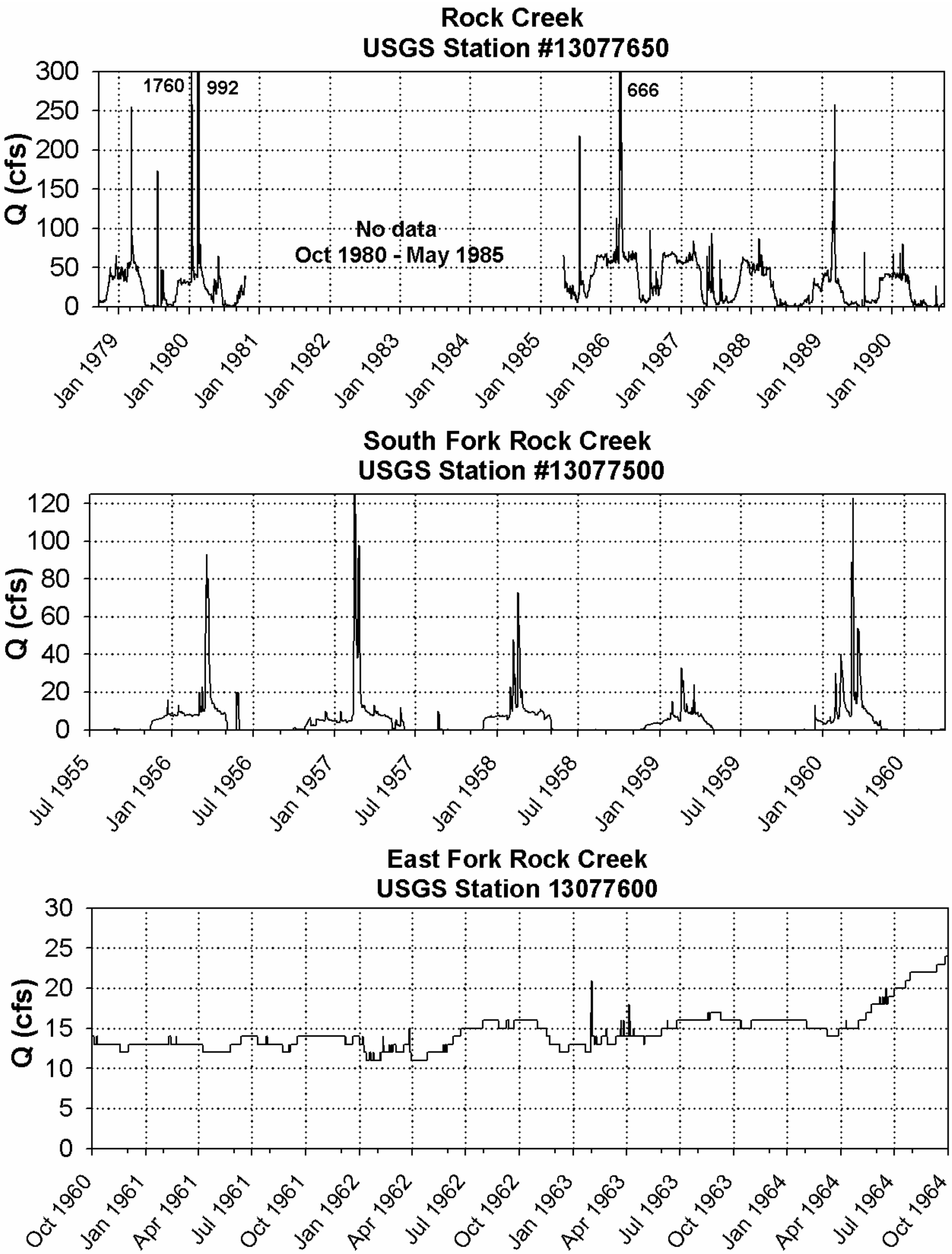

Figure 3. USGS Stream Gage Discharge Data 1955 – 1990

Rock Creek and South Fork Rock Creek

Flow patterns at the IASCD monitoring sites followed similar patterns to the data from the USGS gage. The lack of peak flows on the IASCD hydrograph is attributable to the frequency of measurements. There were peak flows, but they were not measured or sampled. During the 1999-2000 monitoring, stream flow generally increased downstream through the Rockland Valley (Figure 4). A large difference in flow was observed between sites SF1 to RC1. The East Fork combines with the South Fork between those two sites and provides approximately 2/3 of the total flow in Rock Creek. Stream flow increased during winter in the downstream direction. Average summer flows were between 38% and 48% of winter flow levels at all sites on Rock Creek and the South Fork.

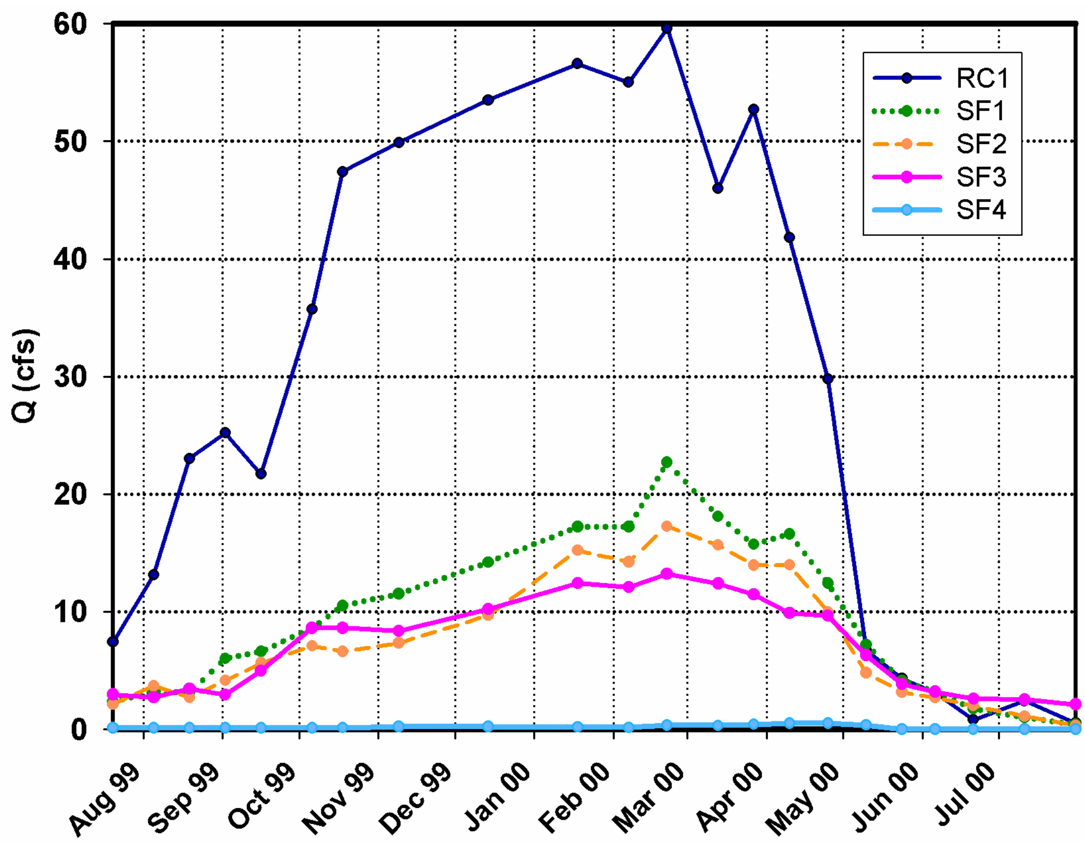

Figure 4. Stream Discharge at Rock Creek and South Fork Monitoring Sites

Stream flow on the South Fork of Rock Creek is fed by several perennial springs 11 miles south of Rockland. The highest spring is located just above site SF4, but the majority of them are between SF4 and SF3. The small spring above SF4 was dry for the last three months of the project and flow was never more than 0.5 cfs at site SF4. Average flows at SF4 and SF3 were 0.2 and 7.6 cfs respectively. Contrary to the general increase during the winter, stream discharge during the peak irrigation season (Jun-Aug) actually decreased below SF3 due to water diversions for irrigation. Site SF3 had the highest average discharge of all the sites on the South Fork during the summer because it is just below the springs and the majority of the water diversions are downstream of that site.

The most important aspect of stream discharge on Rock Creek and the South Fork is the spring flow that remains relatively consistent from year to year and the variability in short duration peak flows. Figure 5 shows stream discharge data from 1999-2000 (site RC1), graphs of flow from each of the 7 years the USGS gage was maintained and the average of those 7 years. Winter flows were consistently between 40-60 cfs and flows during the irrigation season have been near 10 cfs. The only large difference has been the frequency and magnitude of peak-flow events. Peak flows are of very short duration and occur almost exclusively during two critical time-periods: January – March and July – September. The flashy nature of precipitation and runoff patterns in Rockland Valley creates the potential for substantial erosion and sediment transport.

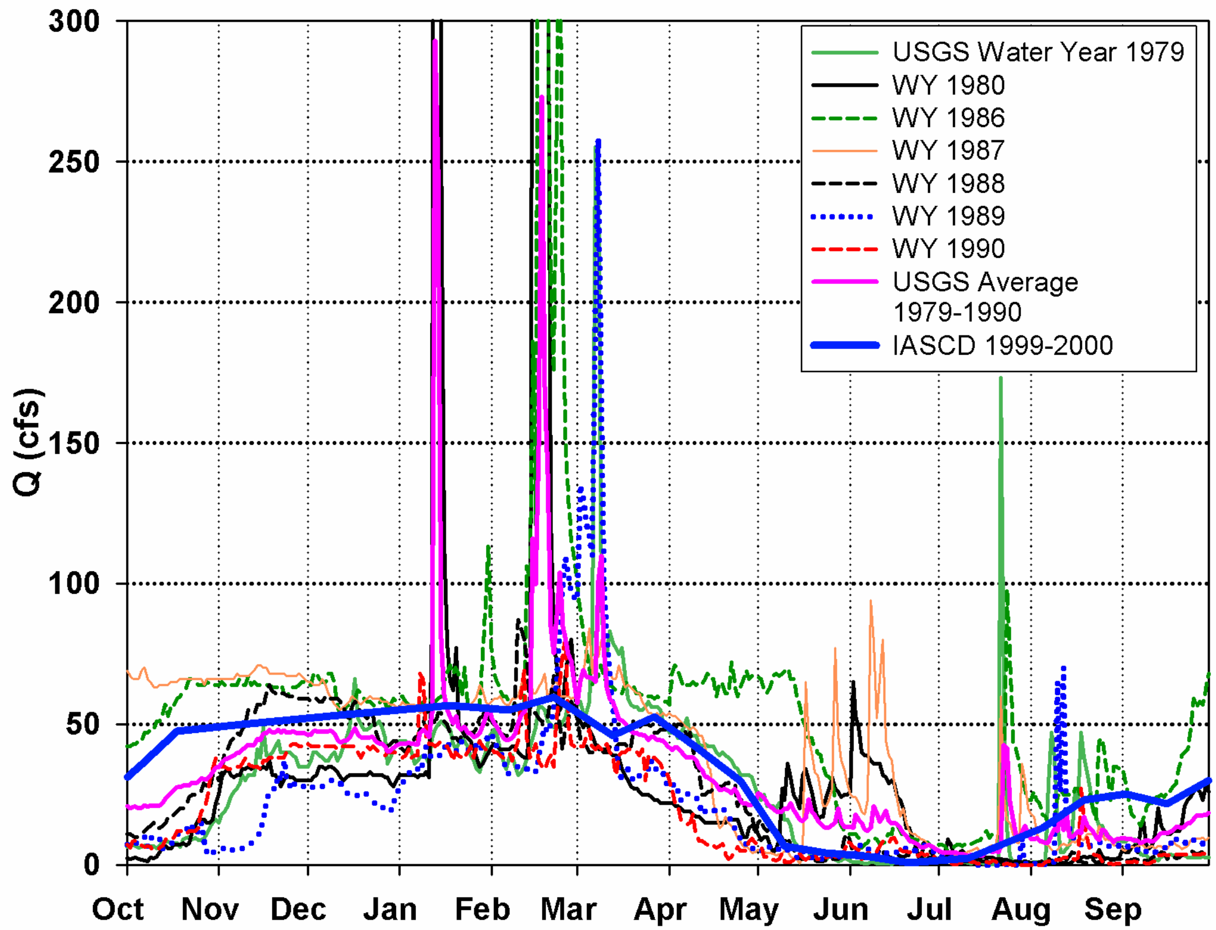

Figure 5. IASCD and USGS Stream Discharge Data

East Fork Rock Creek

Rock Creek begins at the confluence of the East and South Forks of Rock Creek. During this project the East Fork Rock Creek provided approximately two-thirds of the flow to Rock Creek (21.1 cfs) and the South Fork one-third (10.2 cfs). Stream discharge in the East Fork originates from springs at the base of the Deep Creek Mountains 6 miles east of Rockland. Average flow at site EF2, immediately below the springs, was the least variable of all the sites in this project and averaged 24.6 cfs. Flow at EF2 varied between 20.2 cfs and 30.2 cfs with a steady decrease from

September 1999 through June 2000. The decrease was very gradual with no individual measurement varying by more than 3.0 cfs from the previous measurement.

Irrigation withdrawals from Bench Ditch reduce flow in the East Fork during the irrigation season and create more variability at EF1 than at EF2. During the non-irrigation season flow at EF1 averaged 3.6 cfs more than at EF2 while during the irrigation season EF1 averaged 8.0 cfs less than at EF2. A hydrograph of the flows measured at both East Fork sites is included in Figure 5. Flow in the East Fork is generally much more consistent than in Rock Creek or the South Fork. Peak flows on the East Fork are less frequent and of less magnitude and minimum flows are much greater. When peak flows do occur on the East Fork, they occur in the lower three or four miles of the creek, below several ephemeral tributaries.

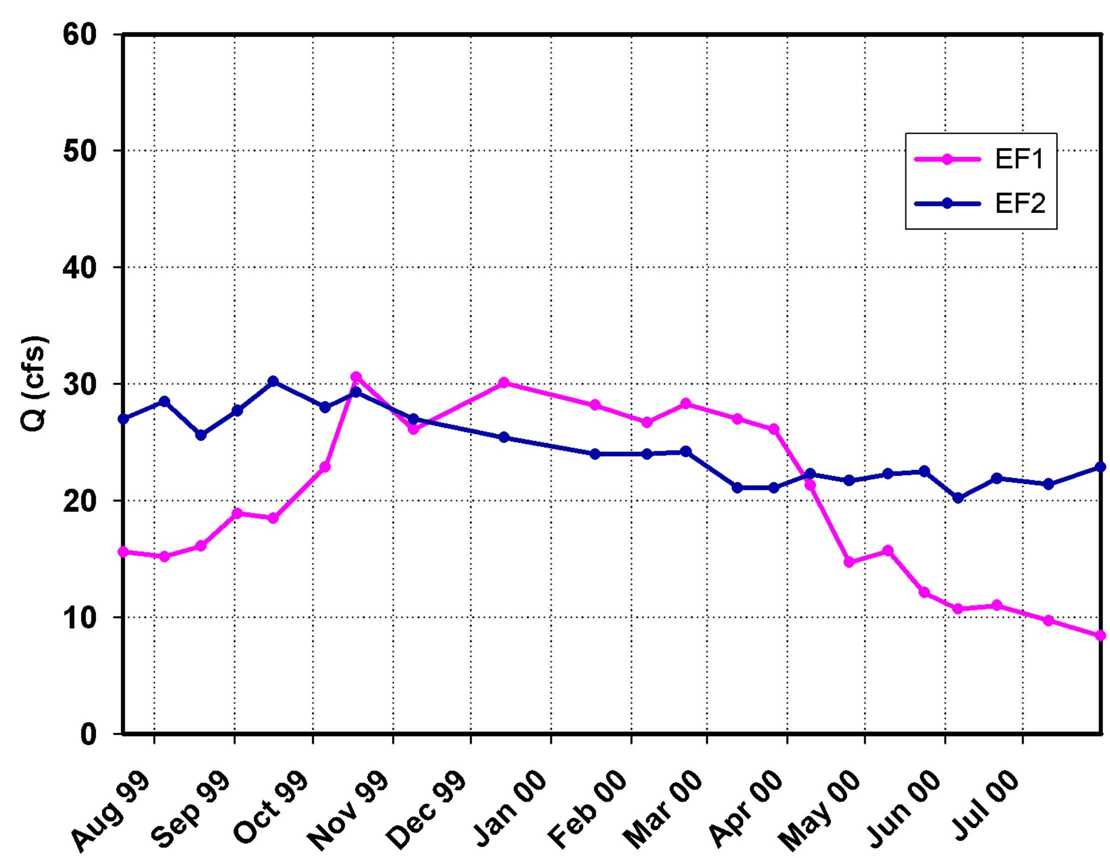

Figure 6. Stream Discharge at East Fork Rock Creek Monitoring Sites

Total Suspended Solids

Rock Creek and South Fork Rock Creek

In general, TSS concentrations on Rock Creek and the South Fork were above the 50 mg/L monthly average during the winter and below it during the summer (Table 5). However, only sites SF1 and SF2 followed that pattern without exception. Rock Creek was above the standard continually from September - April. Site SF3 on the South Fork exceeded the standard at various times throughout the year, with no obvious seasonal pattern (Table 5).

All sites except SF4 and RC0 exceeded the standard of 50 mg/L at least 4 months during the 13 months of this project, primarily between November and March. RC0 exceeded the standard for only two months, but no samples were taken during the winter. Results for all analysis of RC0 apply only the months of data collection at that site (March – July) and do not include data from the peak flow period. The standard was exceeded only once at SF4, where flow never exceeded 0.5 cfs and TSS was also low.

Table 5. Mean Values for TSS Concentration by Month

	Monitoring Site							
Month	**RC0**	**RC1**	**EF1**	**EF2**	**SF1**	**SF2**	**SF3**	**SF4**
Jul 1999	__ [a]	33	100	5	27	9	31	7
Aug 1999	__ [a]	38	94	3	15	12	14	9
Sep 1999	__ [a]	52	61	1	12	23	78	132
Oct 1999	__ [a]	62	71	2	26	23	51	32
Nov 1999	__ [a]	97	29	2	45	39	42	6
Dec 1999	__ [a]	194	49	3	101	109	67	3
Jan 2000	__ [a]	285	82	1	73	109	63	ice[b]
Feb 2000	__ [a]	232	84	1	233	114	126	48
Mar 2000	159	171	53	1	60	96	71	17
Apr 2000	70	55	32	1	20	20	34	6
May 2000	6	11	19	1	10	20	56	7.0
Jun 2000	10	8	70	1	16	56	64	dry
Jul 2000	5	8	26	1	6	6	12	dry
#violations / n	2 / 5	8 / 13	8 / 13	0 / 13	4 / 13	5 / 13	8 / 13	1 / 13

shaded cells indicate value above TMDL standard for TSS
[a] no data collected
b ice cover; no sample taken

All sites on Rock Creek and the South Fork except SF4 saw a rise in TSS levels when the irrigation season ended in the fall of 1999. TSS concentrations were above the 50-mg/L standard from November through March at all sites except SF4. TSS values and stream discharge levels were both at their maximum during the winter. To determine whether stream discharge and TSS levels were related, correlation coefficients and P values were determined for data from each site. Results (Table 6) indicate that there is a statistical correlation between stream discharge and TSS concentrations at all sites on Rock Creek and the South Fork except RC0 and SF4. Again, however, results at RC0 apply only to period of data collection (March – July) and do not include the entire year's data.

Table 6. Correlation Coefficient and P Value for TSS and Q Data

Site	Correlation Coefficient	P Value
RC0	0.613	0.067
RC1	0.896	0.000
SF1	0.739	0.000
SF2	0.678	0.000
SF3	0.545	0.009
SF4	-0.051	0.848
EF1	0.372	0.087
EF2	0.459	0.032

Positive correlation where correlation coefficient >0.0 and P value<0.05

The correlation between stream discharge and TSS concentrations indicate that the two parameters rise and fall together. In the case of stream discharge and TSS concentrations, it is safe to infer from the data that elevated TSS concentrations in Rock Creek and the South Fork are influenced by stream discharge. This suggests that TSS levels on Rock Creek and the South Fork at site SF3 and below are influenced primarily by storm driven runoff events and increased stream energy related to the higher stream flows.

There were large decreases in TSS values during the summer at sites RC0, RC1, SF1 and SF2 (Table 5). All of the sites along Rock Creek and the South Fork showed this seasonal pattern except SF3. Site SF3 was unique in that it exceeded standards regularly during the irrigation season in addition to the winter. Possible explanations for this difference could include several contributing factors. First, site SF3 is located approximately two miles downstream from most of the major springs. Water diversions never reduced flow to less than 2.1 cfs at SF3. Sites below SF3 all experienced lower average flows during the irrigation season. The higher flow at SF3 had more energy to carry sediment. Second, land directly surrounding the springs and along the creek upstream of SF3 is primarily used as pasture. Livestock had constant access to most of the stream through this reach. Constant livestock grazing may be causing increased stream bank erosion due to decreased vegetative cover of stream banks. Finally, several major ephemeral tributaries enter the South Fork immediately upstream of site SF3. Flint and Hartley Canyon from the west and Big Canyon from the east all enter the South Fork within ¼ mile upstream of SF3. Sediment loads deposited in the South Fork from these tributaries could result in higher TSS levels immediately below their confluence. A combination of these factors could explain the higher TSS levels at SF3.

The sources of sediment that create high TSS levels through most of Rock Creek and the South Fork appear to be a combination of stream bank erosion and the reworking of sediment previously deposited in the channel from upland erosion. The relative contribution of each source is impossible to determine from the data collected in this project. However, from observations made during the project, both sources appear to be major sources of sediment.

Delivery of sediment to the main channels from upland runoff was seen once during the 13 months of this project. In August of 1999, an intense thunderstorm on the benches between Rockland and American Falls delivered a substantial flow of sediment laden runoff to lower Rock Creek through Rocky Hollow. We know from USGS records that flood events in the Rockland Valley are large and of short duration. Much of the sediment delivered to Rock Creek likely occurs during these major events and is deposited in the channel and reworked by the stream during subsequent high flows.

The extent of stream bank erosion in the Rockland Valley is more difficult to determine. Most of the observations during this project were made from the eight monitoring sites and from main roads throughout the valley. No thorough assessments of stream bank conditions have been made. However, it is obvious that much of the stream has very little vegetation along its banks and the stream in incised anywhere from 3 to 12 feet below the surrounding fields. Exposed, vertical and unvegetated stream banks are common on both Rock Creek and the South Fork. Livestock grazing and fields plowed directly to the channel edge are the major agricultural practices that are impacting riparian vegetation.

There has been significant effort over the past 20 years to improve water quality in the Rockland Valley. Landowners working with the Power SCD and NRCS have used USDA programs (Conservation Reserve Program – CRP and Public Lands 566 – PL 566) to assist in implementing upland best management practices. CRP converted thousands of acres of erodible dryland fields to perennial vegetation and dozens of terraces and gully plugs were constructed through the PL 566 projects. Although sediment levels are still above standards, local landowners indicate there is a noticeable difference in water appearance since CRP and PL 566 projects began. The efforts to improve water quality have likely made large improvements in sediment levels over the past 20 years. However, no data exists prior to implementation of those practices to assess their effectiveness.

East Fork Rock Creek

TSS levels at each site on the East Fork were very different. Total suspended solids concentrations at EF2, just below the springs, never exceeded 5 mg/L and averaged less than 2 mg/L (Table 5). Six miles downstream TSS levels at EF1 ranged from 12 mg/L to 116 mg/L, with an annual average of 58 mg/L. Average TSS concentrations exceeded the monthly standard of 50 mg/L for 8 months during this project and five of those eight months were during the irrigation season (Table 5). Three of the highest TSS measurements taken at this site were collected in July 1999, August 1999 and June 2000. Patterns of high TSS concentrations during the irrigation season, when stream discharge was at its lowest levels, suggest that irrigation management and tail water runoff are major causes of increased sediment loads in lower sections of the East Fork. Some observations were made of flow returning to the creek through ditches and pasture flood irrigation that contributed large sediment loads to the creek.

TSS concentrations on the East Fork were also above the standard during much of the non-irrigation season. Runoff from snowmelt on steep dryland fields on the south side of the creek was observed delivering sediment to the channel on two separate occasions. Evidence of runoff events from dryland fields north of the creek was also seen in several gullies that drain into the East Fork. Higher stream discharge during the winter also provided more energy to erode banks and transport the sediment deposited in the channel through the ephemeral gullies.

Elevated sediment concentrations on the East Fork appear to have three major causes. First, runoff from pasture flood irrigation and return flows from poorly managed ditches deliver sediment directly to the stream during the irrigation season. Second, runoff from steep, dryland farm slopes surrounding the creek occurs during snowmelt events in late winter and again during late summer thunderstorms and enters the creek through ephemeral gullies that drain the upland slopes and dryland fields. Third, livestock grazing along the lower three miles of the East Fork also has created some sections where vegetative cover along the stream is minimal and increased stream flows erode stream banks and increase sediment loads.

Bacteria

Bacterial contamination was not identified as a problem on the 303(d) list for Rock Creek, South Fork or East Fork. However, samples were collected for eschericia coli (*E. Coli*) because *E. Coli* standards for water quality apply to waters where recreation is listed as a beneficial use. For a water body where primary contact recreation is a designated beneficial use, a one-time measurement exceeding 406 cfu should be followed by four additional samples within 30 days. For secondary contact recreation, the value is 576 cfu. For both primary and secondary contact recreation, the 30-day geometric mean should not exceed 126 cfu. Standards for primary contact recreation apply to Rock Creek while standards for secondary contact recreation apply to the South and East Forks.

Samples for this project were collected on a biweekly basis for this project. The procedure to determine actual violations of state standards as described above were not followed and 30-day geometric means were not calculated. Values above the trigger values of 406 and 576 cfu are shaded in Table 6. This does not indicate an actual violation of the state standard, since sufficient samples were not collected to determine 30-day geometric means. Table 7 is only an indication of the percent of time the samples exceeded the trigger value, not an actual violation of the state standard.

Bacterial contamination throughout the Rockland Valley occurs, but it only appears to be significant on the upper sections of the South Fork of Rock Creek. Site SF3 and SF4 were the only sites with consistently high values (Table 7). Possible sources of bacteria include wildlife, livestock and septic systems from residential homes. However, wildlife impacts are not unique to these two sites, leaving livestock and septic systems as the likely possible sources.

Table 7. *E. Coli* Bacteria Sample Results

Date	RC0	RC1	SF1	SF2	SF3	SF4	EF1	EF2
20-Jul-99	—[a]	200	600	300	700	100	1000	<10
5-Aug-99	—[a]	500	300	70	110	20	100	<10
19-Aug-99	—[a]	1600	100	400	120	30	160	<10
2-Sep-99	—[a]	80	5	<10	30	5600	20	<10
16-Sep-99	—[a]	800	200	120	900	3900	700	<10
6-Oct-99	—[a]	200	300	300	400	1000	100	<10
18-Oct-99	—[a]	400	600	100	400	500	100	<10
9-Nov-99	—[a]	90	10	<1	40	30	20	<1
14-Dec-99	—[a]	<10	20	<10	<10	<10	130	<10
18-Jan-00	—[a]	10	<10	<10	30	—[a]	30	<10
7-Feb-00	—[a]	<10	<10	<10	10	10	20	<10
22-Feb-00	—[a]	<10	<10	40	<10	<10	10	<10
13-Mar-00	—[a]	20	<10	<10	10	<10	<10	<10
27-Mar-00	10	<10	<10	<10	20	<10	20	<10
10-Apr-00	10	20	<10	<10	10	<10	<10	<10
25-Apr-00	<10	<10	10	<10	<10	20	10	<10
10-May-00	60	30	120	40	300	<10	90	<10
24-May-00	80	50	100	50	500	—[b]	10	<10
6-Jun-00	100	100	160	130	1900	—[b]	100	20
21-Jun-00	1300	160	320	200	600	—[b]	200	10
11-Jul-00	220	600	400	200	2600	—[b]	30	20
31-Jul-00	20	100	100	150	300	—[b]	100	10
#violations/n %	1 / 9 11%	4 / 22 18%	2 / 22 9%	0 / 22 0%	5 / 22 23%	3 / 16 19%	2 / 22 9%	0 / 22 0%

shaded cells indicate value above state ‘trigger value’

[a] no data collected

[b] stream flow zero; no data collected

The only anomaly in the bacteria data overall appears to be the fact that *E. Coli* concentrations were higher during the summer of 1999 than the summer of 2000, even though stream discharge was higher in 1999. There was no obvious explanation for the difference in concentrations. However, no stream in the Rockland Valley is listed for bacterial contamination on the state 303(d) list. Agricultural best management practices that will be implemented along the upper sections of the South Fork to address sediment and erosion should also reduce agricultural bacterial contamination as well.

Conclusions

Rock Creek and South Fork Rock Creek

Total suspended solid concentrations exceeded TMDL standards from December through March at all sites on the South Fork and from September through April on Rock Creek. Higher stream flow during the winter increases TSS concentrations by providing increased energy to carry sediment and erode banks. Stream bank erosion and the upland erosion appear to be the major sources of sediment and are both controlled by the flashy precipitation and runoff patterns of the Rockland Valley and vegetation cover during the critical runoff periods. Stream banks that are over grazed or plowed through have little vegetation or root structure to hold stream banks in place during high flows. Dryland grain fields left with little plant residue or that are excessively tilled reduce soil infiltration and contribute to intense runoff events that carry topsoil to the stream channel.

Natural precipitation and snowmelt patterns in the Rockland Valley have the potential to create flashy runoff events. However, the conditions of riparian areas and upland fields can contribute to the magnitude of these natural events and the amount of sediment carried into Rock Creek. This is evidenced by the reduction in observed peak flood flows and related upland erosion after thousands of acres of dryland fields were converted to perennial vegetation through the Conservation Reserve Program during the past 15 years. Although improvements have been made, sediment levels exceed standards and specific areas where dryland field and riparian management is poor continue to deliver sediment to the stream.

Additionally, site SF3 exceeded the standard for four months during the irrigation season. High levels of TSS during the irrigation season at SF3 appear to be related to a combination of relatively high stream discharge during the irrigation season, sediment inputs from ephemeral tributaries and sparse riparian vegetation around the springs and along the South Fork.

East Fork Rock Creek

The East Fork of Rock Creek rapidly degrades below its spring source. Total suspended solid concentrations exceeded the TMDL monthly standard of 50 mg/L for 8 of the 13 months during this project. The lower half of the East Fork, similar to the South Fork, is impacted by sediment delivery from ephemeral tributaries during late winter and late summer runoff events. The condition of dryland fields plays a large role in how quickly water runs off steep slopes and how much sediment is delivered to the stream channel. The lower sections of the East Fork also have very little riparian vegetation to provide support to stream banks during high flow events. In addition, the East Fork is also impacted by return flows from surface irrigation ditches and flood irrigation of pastures. Return flows from flood irrigation and poorly regulated ditches contributed to high TSS levels during the irrigation season.

Recommendations

Rock Creek and South Fork Rock Creek

To identify specific sources of erosion and sediment, more detailed assessments of riparian conditions and steep cropland conditions should be done. Riparian assessments along the main stream channels should help identify specific sections that are actively eroding and prioritize reaches for implementation of best management practices. Most of the lengths of Rock Creek and the South Fork appear to have very little riparian vegetation. An assessment of riparian conditions will identify priority areas. An assessment of dryland agricultural fields, particularly those on steep slopes, should be done to identify areas where erosion of cropland is occurring. A review of past implementation of best management practices (CRP, terraces, gully plugs) should accompany this process to give credit to improvements already made.

Plans for implementation of future agricultural best management practices on Rock Creek and the South Fork should focus on the following:

- Improving soil infiltration rates of dryland fields during critical periods from January through March and again from July through September.
- Increasing riparian vegetation along all of Rock Creek and the South Fork.
- Improved livestock management on pastures surrounding the major springs that feed the South Fork.

East Fork Rock Creek

Sources of sediment to the East Fork included irrigation runoff, upland runoff and stream bank erosion. In addition to undergoing riparian assessments and cropland reviews as described for Rock Creek and the South Fork, efforts should give focus on reducing sediment delivery to the stream from the sources listed above. Specific best management practices on the East Fork should emphasize:

- Improving irrigation diversions and irrigation management along the lower three miles of the stream.
- Reducing runoff from dryland fields during late winter and late summer.
- Increasing riparian vegetation along the lower three miles of Rock Creek.

Improved irrigation management, though a combination of improved diversion structures and irrigation techniques should be emphasized to reduce agricultural runoff to the stream during the irrigation season. Best management practices should be implemented along the stream to increase deep-rooted vegetation and reduce the amount of bare soil along the stream banks. Practices on dryland fields should focus on various reduced tillage methods and crop residue practices to reduce runoff. Some extremely steep, non-productive sections of slopes could be taken out of production without any negative effect to the landowner. Some small sections that produced significant runoff were not even harvested due to poor production. Perennial vegetation in these small areas would benefit both water quality and the landowner.

References

1. Dallon, M. V., 1999. Rock Creek Water Quality Monitoring Project. Idaho Association of Soil Conservation Districts.

2. Fowler, Roy, 2001. District Conservationist, Natural Resources Conservation Service, personal communication.

3. Idaho Administrative Code, Department of Environmental Quality. IDAPA 58.01.02, “Water Quality Standards and Wastewater Treatment Requirements”.

4. Idaho State Climate Services: http://snow.ag.uidaho.edu:8642/month_index.htm, January 2002.

5. Lay, C.H., 1999. The Lake Walcott Subbasin Assessment and Total Maximum Daily Load. Idaho Division of Environmental Quality.

6. Miller, T.E., 1998. The Walcott Watershed of the Snake River, Idaho: A Sub-Basin Assessment of HUC 17040209. Idaho Division of Environmental Quality.

7. Shelton, L.R., 1994. Field Guide for Collecting and Processing Stream-Water Samples for the National Water-Quality Assessment Program. United States Geological Survey, Department of the Interior. Also at http://water.wr.usgs.gov/pnsp/pest.rep/sw-t.html

8. United States Geological Survey. http://waterdata.usgs.gov/nwis/discharge/?site_no=13077650, January 2002.

9. United States Geological Survey. http://waterdata.usgs.gov/nwis/discharge/?site_no=13077500, January 2002.

10. United States Geological Survey. http://waterdata.usgs.gov/nwis/discharge/?site_no=13077600 January 2002.

11. University of Idaho, Department of Geography, 1995. Mean Annual Precipitation, 1961 – 1990, IDAHO.

12. Williams, R.P. and H.W. Young, 1982. Water Resources of Rockland Basin, Southeastern Idaho. U.S. Geological Survey, Department of the Interior.

Appendix A
Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC)

Procedures for quality assurance and quality control for this project were outlined prior to monitoring in June of 1999 (Dallon 1999). Magic Valley Labs in Twin Falls, Idaho analyzed all samples. Magic Valley Labs used EPA approved and validated methods, although they are incompetent sons of bitches that should refund every dime they got from us.

Duplicate samples and blank samples were collected as part of the field QA/QC procedures. Duplicates and blanks were collected at 10% of the total sample load. Blank samples consisted of deionized water handled as if it were a normal sample. For samples requiring filtering, deionized water was put through the filtration unit and transferred to a sample container. There were no constituents detected above the detection limit for any of the blank samples analyzed during this project.

All of the duplicate samples were collected from site RC1 on Rock Creek. Duplicate samples were not identified as such during analysis by the laboratory to determine laboratory precision. Blank and duplicate samples were stored, handled and transported with the other samples to the laboratory. A comparison of mean values for parameters when duplicates were collected and the mean value of duplicate samples is presented in Table 8. This table is not an indication of precision between individual measurements, but of the mean values of samples and duplicate samples.

Table 8. Duplicate Sample Comparison

Parameters	RC1 Mean	Duplicate Mean	Relative Percent Difference
TSS	18.0	18.3	101.4
TVSS	8.3	9.0	108.0
Nitrate	0.20	0.21	105.0
TKN	0.70	0.84	120.4
Ammonia	0.04	0.03	86.2
Total P	0.08	0.09	116.1
Orthophosphate	0.05	0.07	142.1
Fecal Coliform	900	725	80.6

The relative percent difference (RPD) between each individual sample and its corresponding duplicate sample are presented in Table 9. The RPD is a measure of precision for duplicate samples and is calculated with the following equation:

$$RPD = \frac{(C_1 - C_2) \times 100\%}{(C_1 + C_2) / 2}$$

RPD = relative percent difference
C_1 = Larger of two samples
C_2 = Smaller of two samples

Table 9. Relative Percent Difference (duplicates)

Collection Date	TSS	TSS Duplicate	RPD	TVSS	TVSS Duplicate	RPD	NO_3	NO_3 Duplicate	RPD
20-Jul-99	33	33	0.0	16	17	6.1	1.73	1.68	2.9
05-Aug-99	44	42	4.7	10	9	10.5	1.37	1.15	17.5
19-Aug-99	32	28	13.3	6	4	40.0	1.17	1.27	8.2
16-Sep-99	53	49	7.8	7	9	25.0	1.46	1.60	9.2
06-Oct-99	10	9	10.5	6	6	0.0	1.47	1.47	0.0
18-Oct-99	114	121	6.0	15	13	14.3	1.30	1.28	1.6
09-Nov-99	97	100	3.0	9	11	20.0	1.28	1.22	4.8
14-Dec-99	194	200	3.0	34	36	5.7	1.12	1.15	2.6
18-Jan-00	285	291	2.1	27	28	3.6	1.20	1.32	9.5
07-Feb-00	223	268	18.3	17	21	21.1	1.11	1.09	1.8
13-Mar-00	200	210	4.9	19	19	0.0	0.90	0.93	3.3
27-Mar-00	141	110	24.7	13	11	16.7	1.23	1.12	9.4
25-Apr-00	39	39	0.0	7	5	33.3	0.90	0.86	4.5
10-May-00	11	11	0.0	4	5	22.2	1.31	1.25	4.7
24-May-00	10	10	0.0	6	6	0.0	1.10	1.14	3.6
06-Jun-00	10	7	35.3	5	5	0.0	1.23	1.28	4.0
21-Jun-00	5	6	18.2	3	5	50.0	1.30	1.31	0.8
31-Jul-00	13	13	0.0	5	7	33.3	1.30	1.23	5.5

Collection Date	NO_2	NO_2 Duplicate	RPD	Total P	Total P Duplicate	RPD	Ortho P	Ortho P Duplicate	RPD
20-Jul-99	0.018	0.014	25.0	0.15	0.22	37.8	0.15	0.22	37.8
05-Aug-99	0.011	0.010	9.5	0.12	0.13	8.0	0.12	0.13	8.0
19-Aug-99	0.013	0.013	0.0	0.28	0.27	3.6	0.23	0.27	16.0
16-Sep-99	0.006	0.006	0.0	0.16	0.15	6.5	0.06	0.07	15.4
06-Oct-99	0.003	0.003	0.0	0.37	0.34	8.5	0.20	0.18	10.5
18-Oct-99	<0.003	<0.003	0.0	0.18	0.22	20.0	0.17	0.13	26.7
09-Nov-99	<0.003	<0.003	0.0	0.17	0.16	6.1	0.08	0.09	11.8
14-Dec-99	<0.003	<0.003	0.0	0.27	0.27	0.0	0.11	0.04	93.3
18-Jan-00	<0.003	<0.003	0.0	0.28	0.37	27.7	0.07	0.04	54.5
07-Feb-00	0.003	0.003	0.0	0.26	0.33	23.7	0.11	0.10	9.5
13-Mar-00	0.004	0.003	28.6	0.17	0.16	6.1	0.16	0.16	0.0
27-Mar-00	0.003	0.003	0.0	0.15	0.18	18.2	0.14	0.18	25.0
25-Apr-00	0.003	0.004	28.6	0.06	0.09	40.0	0.05	0.09	57.1
10-May-00	0.010	0.008	22.2	0.18	0.18	0.0	0.18	0.17	5.7
24-May-00	0.022	0.023	4.4	0.21	0.19	10.0	0.17	0.17	0.0
06-Jun-00	0.028	0.029	3.5	0.16	0.16	0.0	0.09	0.14	43.5
21-Jun-00	0.063	0.064	1.6	0.65	0.66	1.5	0.57	0.51	11.1
31-Jul-00	0.033	0.033	0.0	0.27	0.25	7.7	0.27	0.23	16.0

Table 9. Relative Percent Difference (continued)

Collection Date	NH3	NH3 Duplicate	RPD	TKN	TKN Duplicate	RPD	*E. Coli*	*E. Coli* Duplicate	RPD
20-Jul-99	<0.05	<0.05	0.0	3.49	5.48	44.4	200	100	66.7
05-Aug-99	<0.05	<0.05	0.0	2.38	2.55	6.9	500	600	18.2
19-Aug-99	0.15	0.12	22.2	1.63	1.60	1.9	1600	2000	22.2
16-Sep-99	<0.05	<0.05	0.0	0.98	0.92	6.3	800	700	13.3
06-Oct-99	<0.05	<0.05	0.0	2.79	3.01	7.6	200	200	0.0
18-Oct-99	<0.05	<0.05	0.0	0.84	0.86	2.4	400	400	0.0
09-Nov-99	0.32	0.39	19.7	2.60	3.02	14.9	90	10	160.0
14-Dec-99	0.16	0.13	20.7	4.12	3.42	18.6	<10	<10	0.0
18-Jan-00	0.07	0.08	13.3	2.57	2.36	8.5	10	10	0.0
07-Feb-00	0.07	0.07	0.0	3.09	3.31	6.9	<10	10	0.0
13-Mar-00	<0.05	<0.05	0.0	3.69	4.01	8.3	20	<10	120.0
27-Mar-00	<0.05	<0.05	0.0	1.67	1.66	0.6	<10	10	0.0
25-Apr-00	<0.05	<0.05	0.0	2.61	2.35	10.5	<10	<10	0.0
10-May-00	<0.05	<0.05	0.0	1.97	1.59	21.3	30	10	100.0
24-May-00	<0.05	<0.05	0.0	1.66	2.18	27.1	50	100	66.7
06-Jun-00	<0.05	<0.05	0.0	2.55	2.31	9.9	100	130	26.1
21-Jun-00	<0.05	<0.05	0.0	0.68	0.61	10.9	160	110	37.0
31-Jul-00	<0.05	<0.05	0.0	0.47	0.24	64.8	100	280	94.7

Appendix B
Water Quality Data Sheets

Rock Creek 0 RC0

Date	Q ft3/s	DO mg/L	Temp °C	Cond µS	Salinity	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
27-Mar-00	56.7	9.88	8.5	623	0.3	297	8.16	159	15	1.32	0.004	0.23	0.07	<0.05	3.26	100	10	10:30
10-Apr-00	39.4	9.68	9.1	674	0.3	318	8.00	91	15	1.05	0.004	0.13	0.09	<0.05	2.66	80	10	9:00
25-Apr-00	27.4	9.60	9.6	720	0.3	344	8.13	48	6	0.98	0.003	0.09	0.07	<0.05	3.42	<10	<10	10:30
10-May-00	8.5	9.54	9.9	763	0.4	363	8.02	6	4	1.58	0.008	0.18	0.10	<0.05	1.79	60	60	10:00
24-May-00	6.1	8.29	16.6	787	0.4	379	8.21	6	3	1.18	0.019	0.13	0.11	<0.05	2.51	80	80	11:00
6-Jun-00	2.9	8.45	15.6	847	0.4	409	8.20	10	6	1.09	0.023	0.11	0.10	0.12	0.48	100	100	9:30
21-Jun-00	1.4	9.92	15.7	853	0.4	413	8.13	10	6	1.06	0.024	0.33	0.28	<0.05	0.60	2000	1300	10:30
11-Jul-00	3.5	9.47	19.6	957	0.5	464	8.49	7	7	1.1	0.019	0.37	0.32	<0.05	1.31	220	220	12:00
31-Jul-00	2.2	7.98	18.9	855	0.4	412	8.30	3	3	1.13	0.007	0.26	0.20	<0.05	0.26	30	20	9:30

Rock Creek 1 RC1

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	7.4	9.02	13.9	848	0.4	410	7.65	33	16	1.73	0.018	0.15	0.15	<0.05	3.49	300	200	9:00
5-Aug-99	13.1	8.57	14.4	738	0.4	355	7.97	44	10	1.37	0.011	0.12	0.12	<0.05	2.38	500	500	8:00
19-Aug-99	23.0	8.46	14.7	899	0.4	434	8.18	32	6	1.17	0.013	0.28	0.23	0.15	1.63	2900	1600	9:45
2-Sep-99	25.2	9.18	11.6	828	0.4	396	8.14	51	11	1.44	0.005	0.15	0.08	<0.05	3.40	300	80	10:00
16-Sep-99	21.7	9.26	10.8	788	0.4	379	8.12	53	7	1.46	0.006	0.16	0.06	<0.05	0.98	1200	800	10:00
6-Oct-99	35.7	9.70	9.5	751	0.4	358	8.25	10	6	1.47	0.003	0.37	0.20	<0.05	2.79	300	200	10:30
18-Oct-99	47.4	10.38	6.1	684	0.3	320	8.23	114	15	1.30	<0.003	0.18	0.17	<0.05	0.84	400	400	11:15
9-Nov-99	49.9	10.37	6.4	672	0.3	317	8.48	97	9	1.28	<0.003	0.17	0.08	0.32	2.60	150	90	11:00
14-Dec-99	53.5	11.27	2.8	682	0.3	307	8.48	194	34	1.12	<0.003	0.27	0.11	0.16	4.12	100	<10	10:30
18-Jan-00	56.6	10.66	5.1	694	0.3	316	8.81	285	27	1.20	<0.003	0.28	0.07	0.07	2.57	30	10	11:00
7-Feb-00	55.0	10.60	5.0	664	0.3	310	n/a	223	17	1.11	0.003	0.26	0.11	0.07	3.09	30	<10	11:30
22-Feb-00	59.6	10.18	7.5	670	0.3	316	n/a	241	34	1.19	<0.003	0.71	0.11	0.14	5.01	40	<10	11:30
13-Mar-00	46.0	10.69	5.3	664	0.3	309	8.31	200	19	0.90	0.004	0.17	0.16	<0.05	3.69	20	20	10:30
27-Mar-00	52.7	9.76	8.9	640	0.3	305	7.92	141	13	1.23	0.003	0.15	0.14	<0.05	1.67	20	<10	12:00
10-Apr-00	41.8	9.87	8.4	698	0.3	329	7.96	71	11	0.89	0.004	0.10	0.08	<0.05	2.02	60	20	10:00
25-Apr-00	29.8	9.72	8.9	741	0.4	353	8.23	39	7	0.90	0.003	0.06	0.05	<0.05	2.61	40	<10	11:30
10-May-00	6.7	9.60	9.3	813	0.4	386	8.17	11	4	1.31	0.010	0.18	0.18	<0.05	1.97	90	30	10:45
24-May-00	4.3	8.40	15.7	864	0.4	417	8.25	10	6	1.10	0.022	0.21	0.17	<0.05	1.66	190	50	12:00
6-Jun-00	3.1	8.49	15.2	946	0.5	456	8.20	10	5	1.23	0.028	0.16	0.09	<0.05	2.55	280	100	10:30
21-Jun-00	0.8	9.18	14.5	975	0.5	470	8.00	5	3	1.30	0.063	0.65	0.57	<0.05	0.68	210	160	11:15
11-Jul-00	2.4	11.17	19.8	904	0.4	436	8.22	3	4	1.28	0.038	0.37	0.37	<0.05	0.56	800	600	13:00
31-Jul-00	0.5	8.15	16.2	909	0.4	438	7.95	13	5	1.30	0.033	0.27	0.27	<0.05	0.47	200	100	10:30

South Fork 1 SF1

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	2.3	9.28	14.5	950	0.5	459	7.83	27	13	1.05	<0.003	0.10	0.10	<0.05	4.01	600	600	10:30
5-Aug-99	3.2	8.55	14.4	915	0.4	441	8.02	14	3	1.02	0.003	0.09	0.09	<0.05	1.64	300	300	9:00
19-Aug-99	3.1	8.48	13.6	478	0.2	451	7.91	15	5	0.67	0.004	0.24	0.22	<0.05	1.49	300	100	10:30
2-Sep-99	6.0	9.19	11.5	971	0.5	468	8.02	14	6	0.88	0.007	0.18	0.16	<0.05	<0.05	30	5	11:15
16-Sep-99	6.6	9.23	11.0	946	0.5	455	8.06	10	4	0.53	0.004	0.16	0.16	<0.05	2.70	500	200	11:15
6-Oct-99	8.6	9.30	11.1	940	0.5	452	8.21	8	3	1.33	0.004	0.11	0.10	<0.05	3.16	300	300	11:50
18-Oct-99	10.5	9.91	7.9	903	0.4	429	8.21	43	9	1.14	<0.003	0.14	0.14	<0.05	2.92	700	600	12:30
9-Nov-99	11.5	9.93	8.0	898	0.4	428	8.46	45	7	1.29	0.004	0.20	0.20	0.06	2.77	40	10	12:00
14-Dec-99	14.2	11.11	3.2	947	0.4	429	8.35	101	16	1.26	0.003	0.19	0.03	0.09	4.06	20	20	11:45
18-Jan-00	17.2	10.53	5.3	933	0.4	427	8.56	73	9	1.29	0.003	0.20	0.17	0.06	3.34	20	<10	12:30
7-Feb-00	17.2	10.12	6.7	856	0.4	405	n/a	83	8	1.00	0.003	0.14	0.12	0.08	2.94	<10	<10	13:00
22-Feb-00	22.7	9.83	8.7	875	0.4	414	n/a	383	41	1.10	0.003	0.72	0.20	0.07	2.12	<10	<10	12:30
13-Mar-00	18.1	10.00	7.5	886	0.4	422	8.18	99	15	1.05	0.003	0.23	0.19	<0.05	2.48	10	<10	11:30
27-Mar-00	15.7	9.08	11.8	864	0.4	416	8.10	20	<1	1.02	0.004	0.28	0.20	<0.05	1.90	10	<10	12:30
10-Apr-00	16.6	9.46	9.9	865	0.4	411	7.92	20	6	1.03	0.004	0.13	0.10	<0.05	0.29	20	<10	11:00
25-Apr-00	12.4	9.10	11.5	872	0.4	417	8.21	19	4	0.63	<0.003	0.09	0.09	<0.05	1.80	100	10	12:15
10-May-00	7.2	9.25	10.9	927	0.4	446	8.06	10	4	1.12	0.008	0.16	0.10	<0.05	0.83	500	120	11:45
24-May-00	4.1	8.23	16.3	877	0.4	424	8.10	9	4	1.06	0.007	0.10	0.09	<0.05	2.15	600	100	13:00
6-Jun-00	3.2	8.60	14.6	893	0.4	432	8.01	20	5	1.08	0.010	0.23	0.20	<0.05	0.44	160	160	11:45
21-Jun-00	1.7	10.03	13.9	935	0.5	452	8.08	12	5	1.12	0.006	0.97	0.90	<0.05	1.90	470	320	11:45
11-Jul-00	1.0	11.56	16.4	883	0.4	427	8.24	4	4	0.78	0.005	0.60	0.45	<0.05	0.20	400	400	14:30
31-Jul-00	0.4	10.11	15.2	943	0.5	458	7.87	7	4	1.10	0.007	0.30	0.29	<0.05	0.22	100	100	11:15

South Fork 2 SF2

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	2.1	8.32	20.6	740	0.4	356	8.56	9	8	0.65	0.006	0.04	0.04	<0.05	2.33	400	300	14:00
5-Aug-99	3.7	8.14	18.1	772	0.4	371	8.29	11	<1	0.61	0.004	0.08	0.03	<0.05	3.18	110	70	11:45
19-Aug-99	2.7	7.90	17.9	839	0.4	405	8.30	12	4	0.65	0.007	0.08	0.08	<0.05	1.59	600	400	13:30
2-Sep-99	4.1	8.57	14.5	745	0.4	359	8.27	22	6	0.90	0.011	0.41	0.34	<0.05	<0.05	680	<10	14:00
16-Sep-99	5.6	8.42	14.6	847	0.4	407	8.27	23	5	0.82	0.005	0.10	0.07	<0.05	0.63	400	120	13:15
6-Oct-99	7.1	9.26	11.4	802	0.4	383	8.45	10	4	1.00	0.003	0.08	0.08	<0.05	0.40	500	300	15:10
18-Oct-99	6.6	9.78	8.7	786	0.4	375	8.40	35	6	0.86	<0.003	0.24	0.20	<0.05	0.69	100	100	15:20
9-Nov-99	7.3	9.92	8.0	828	0.4	392	8.36	39	5	1.09	0.003	0.10	0.10	0.06	0.55	50	<1	14:30
14-Dec-99	9.7	11.32	2.5	865	0.4	388	8.34	109	15	1.06	<0.003	0.23	0.18	0.09	3.72	100	<10	14:45
18-Jan-00	15.2	10.56	4.9	866	0.4	395	8.33	109	12	0.91	0.004	0.18	0.18	0.06	4.78	20	<10	15:15
7-Feb-00	14.2	10.16	6.4	802	0.4	375	n/a	64	8	0.99	0.003	0.16	0.08	0.07	0.60	20	<10	15:15
22-Feb-00	17.2	9.91	8.3	834	0.4	394	n/a	164	20	0.95	<0.003	0.30	0.20	0.06	4.78	40	40	15:30
13-Mar-00	15.6	9.71	8.8	807	0.4	383	8.30	107	14	0.82	0.005	0.26	0.25	<0.05	3.27	20	<10	14:45
27-Mar-00	13.9	9.04	12.0	786	0.4	376	8.25	85	12	0.83	0.004	0.23	0.19	<0.05	0.80	20	<10	15:20
10-Apr-00	14.0	9.30	10.7	759	0.4	363	8.29	23	7	0.75	0.005	0.14	0.14	<0.05	2.11	<10	<10	13:15
25-Apr-00	10.0	9.09	11.7	779	0.4	372	8.27	16	5	0.51	0.003	0.11	0.11	<0.05	0.80	<10	<10	15:00
10-May-00	4.8	9.24	11.0	853	0.4	408	8.27	15	3	0.96	0.008	0.17	0.16	<0.05	0.41	40	40	14:00
24-May-00	3.2	7.60	19.9	810	0.4	390	8.27	24	8	0.80	0.012	0.28	0.20	<0.05	2.06	140	50	15:15
6-Jun-00	2.7	7.64	19.8	825	0.4	397	8.20	39	5	0.77	0.014	0.29	0.12	<0.05	0.61	130	130	14:30
21-Jun-00	2.0	9.56	19.6	791	0.4	380	8.14	73	11	0.76	0.009	0.47	0.45	<0.05	1.55	300	200	13:15
11-Jul-00	1.1	10.96	21.3	732	0.4	352	8.50	6	2	0.35	<0.003	0.63	0.44	<0.05	0.23	700	200	15:15
31-Jul-00	0.3	9.82	21.4	705	0.3	340	8.08	6	2	0.33	0.004	0.35	0.32	<0.05	1.27	400	150	13:15

South Fork 3 SF3

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	3.0	8.08	20.8	758	0.4	364	8.39	31	11	0.62	0.007	0.07	0.07	<0.05	3.56	3900	700	15:00
5-Aug-99	2.7	7.84	18.2	728	0.4	351	8.43	13	9	0.59	0.006	0.05	0.05	<0.05	1.34	470	110	12:45
19-Aug-99	3.4	7.85	17.9	797	0.4	384	8.41	14	4	0.49	0.008	0.20	0.19	<0.05	2.40	1400	120	14:15
2-Sep-99	2.9	8.30	15.9	785	0.4	378	8.29	113	19	0.88	0.011	0.31	0.11	<0.05	0.41	620	30	15:00
16-Sep-99	5.0	8.19	15.9	738	0.4	355	8.39	42	7	0.80	0.007	0.36	0.13	<0.05	0.63	1300	900	14:15
6-Oct-99	8.6	9.59	9.3	761	0.4	361	8.35	51	10	0.77	<0.003	0.21	0.18	<0.05	1.10	400	400	16:00
18-Oct-99	8.6	9.59	9.3	761	0.4	361	8.35	51	10	0.77	<0.003	0.21	0.18	<0.05	1.10	400	400	16:00
9-Nov-99	8.4	9.87	8.0	787	0.4	373	8.51	42	7	0.83	0.004	0.11	0.10	0.06	1.93	50	40	15:15
14-Dec-99	10.2	11.08	3.0	828	0.4	372	8.34	67	18	0.82	<0.003	0.12	0.09	0.07	3.71	<10	<10	15:30
18-Jan-00	12.4	10.41	5.4	833	0.4	382	8.44	63	9	0.99	<0.003	0.20	0.18	0.07	4.53	100	30	16:00
7-Feb-00	12.1	10.12	6.6	766	0.4	358	n/a	60	9	0.61	<0.003	0.07	0.03	0.07	4.09	50	10	16:00
22-Feb-00	13.2	9.95	7.9	818	0.4	385	n/a	191	25	0.80	<0.003	0.55	0.21	0.06	5.25	700	<10	16:15
13-Mar-00	12.4	9.48	9.5	771	0.4	368	8.34	78	14	0.71	<0.003	0.13	0.13	<0.05	4.05	240	10	15:30
27-Mar-00	11.4	8.96	12.4	760	0.4	364	8.17	63	11	0.66	0.003	0.19	0.14	<0.05	1.51	20	20	16:30
10-Apr-00	9.9	8.84	12.9	738	0.4	354	8.36	33	8	0.68	0.005	0.09	0.09	<0.05	1.44	10	10	14:00
25-Apr-00	9.6	8.89	12.3	752	0.4	360	8.25	34	9	0.45	0.003	0.08	0.08	<0.05	2.00	10	<10	15:45
10-May-00	6.3	9.40	10.3	859	0.4	410	7.86	68	12	1.15	0.007	0.31	0.15	<0.05	3.73	400	300	15:00
24-May-00	3.8	7.73	18.7	823	0.4	397	8.14	44	9	0.79	0.008	0.32	0.27	<0.05	3.32	1100	500	16:00
6-Jun-00	3.2	7.38	21.1	825	0.4	398	7.94	83	16	0.75	0.007	0.21	0.20	<0.05	2.20	2200	1900	15:00
21-Jun-00	2.6	9.38	20.0	805	0.4	388	8.00	44	6	0.73	0.004	0.68	0.62	<0.05	3.54	1700	600	14:00
11-Jul-00	2.5	9.69	21.0	765	0.4	367	8.32	10	3	0.51	0.003	0.38	0.35	<0.05	1.33	2600	2600	16:15
31-Jul-00	2.1	14.64	21.8	725	0.4	347	8.31	14	6	0.36	<0.003	0.30	0.26	<0.05	2.10	2600	300	14:00

South Fork 4 SF4

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	0.10	6.85	24.6	421	0.2	200	8.77	7	7	0.32	<0.003	0.15	0.15	<0.05	5.53	200	100	15:45
5-Aug-99	0.10	7.63	19.6	471	0.2	226	8.54	<1	<1	0.37	<0.003	0.14	0.14	<0.05	1.21	100	20	13:30
19-Aug-99	0.10	7.33	21.5	507	0.2	242	8.39	9	4	0.21	<0.003	0.19	0.18	0.06	1.48	200	30	15:00
2-Sep-99	0.10	7.52	20.7	537	0.3	257	8.14	251	35	0.32	<0.003	0.58	0.20	<0.05	0.56	9100	5600	16:00
16-Sep-99	0.10	7.31	21.6	521	0.2	249	8.22	12	4	0.73	<0.003	0.34	0.10	<0.05	1.02	5200	3900	15:00
6-Oct-99	0.10	9.16	11.2	542	0.3	257	8.41	61	10	0.54	<0.003	0.05	0.04	<0.05	0.26	1200	1000	16:30
18-Oct-99	0.12	9.19	10.6	545	0.3	258	8.24	2	1	0.31	<0.003	0.14	0.14	<0.05	1.82	700	500	17:00
9-Nov-99	0.20	9.89	7.5	507	0.2	238	8.50	6	2	0.23	<0.003	0.10	0.10	0.06	0.53	100	30	16:00
14-Dec-99	0.20	11.98	0.0	545	0.2	235	7.88	3	<1	0.34	0.003	0.06	0.06	0.08	1.52	150	<10	16:20
18-Jan-00	ice	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0:00
7-Feb-00	0.14	11.78	0.1	423	0.2	187	n/a	9	4	0.35	<0.003	0.07	0.07	0.06	1.06	60	10	16:45
22-Feb-00	0.32	10.38	6.1	481	0.2	222	n/a	87	14	0.29	<0.003	0.33	0.15	0.06	0.94	200	<10	17:15
13-Mar-00	0.30	9.11	10.9	473	0.2	224	8.87	22	7	0.32	<0.003	0.07	0.07	<0.05	2.34	10	<10	16:30
27-Mar-00	0.40	8.83	12.9	466	0.2	222	8.88	11	5	0.30	<0.003	0.26	0.26	<0.05	3.13	<10	<10	17:30
10-Apr-00	0.50	7.28	21.0	400	0.2	191	8.38	5	3	0.42	<0.003	0.19	0.12	<0.05	1.38	20	<10	14:45
25-Apr-00	0.50	8.03	16.3	460	0.2	220	8.23	7	3	0.28	<0.003	0.15	0.11	<0.05	1.71	100	20	16:15
10-May-00	0.34	8.18	16.4	459	0.2	219	8.30	7	4	0.34	<0.003	0.16	0.11	<0.05	1.09	10	<10	16:00
24-May-00	0.00																	16:45
6-Jun-00	0.00																	15:45
21-Jun-00	0.00																	14:45
11-Jul-00	0.00																	16:00
31-Jul-00	0.00																	15:00

East Fork 1 EF1

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	15.6	9.55	14.5	440	0.2	210	8.33	100	15	0.64	0.01	0.18	0.05	0.07	3.49	1700	1000	11:00
5-Aug-99	15.2	9.07	12.5	450	0.2	215	8.22	106	13	0.80	<0.003	0.14	<0.005	<0.05	1.79	1200	100	10:00
19-Aug-99	16.1	8.72	13.6	478	0.2	228	8.33	81	17	0.50	<0.003	0.04	0.04	<0.05	1.80	400	160	11:30
2-Sep-99	18.9	9.19	11.4	488	0.2	232	8.25	72	9	0.82	<0.003	0.15	0.11	<0.05	1.53	260	20	12:00
16-Sep-99	18.5	9.06	11.7	473	0.2	225	8.31	49	9	1.60	0.01	0.15	0.07	<0.05	0.92	1100	700	12:00
6-Oct-99	22.9	9.32	11.0	483	0.2	230	8.45	57	7	1.01	0.00	0.09	0.06	<0.05	0.64	200	100	12:30
18-Oct-99	30.6	9.64	9.1	471	0.2	221	8.41	85	10	0.74	<0.003	0.12	0.05	0.06	0.94	100	100	13:15
9-Nov-99	26.1	9.71	9.0	458	0.2	216	8.63	29	5	0.73	<0.003	<0.01	<0.005	0.07	0.47	190	20	12:45
14-Dec-99	30.1	10.41	5.7	461	0.2	210	8.57	49	8	0.68	<0.003	0.10	<0.005	0.93	1.93	200	130	12:40
18-Jan-00	28.2	10.04	7.0	452	0.2	208	8.52	82	10	0.65	<0.003	0.18	<0.005	0.06	2.66	50	30	13:00
7-Feb-00	26.7	9.65	8.4	428	0.2	201	n/a	113	14	0.49	<0.003	0.14	0.02	0.09	3.10	40	20	13:45
22-Feb-00	28.3	9.52	9.9	428	0.2	202	n/a	54	6	0.60	<0.003	0.16	0.04	0.11	2.45	40	10	14:45
13-Mar-00	27.0	9.66	9.1	429	0.2	202	8.49	60	5	0.50	<0.003	0.15	0.13	<0.05	2.77	10	<10	12:15
27-Mar-00	26.1	8.94	12.6	401	0.2	191	8.43	45	7	0.42	<0.003	0.03	0.02	<0.05	0.98	20	20	13:15
10-Apr-00	21.3	9.36	10.3	431	0.2	204	7.92	32	6	0.47	0.00	0.03	0.02	<0.05	1.27	<10	<10	11:45
25-Apr-00	14.7	9.11	11.4	445	0.2	211	8.31	31	6	0.55	<0.003	0.06	0.02	<0.05	1.36	70	10	12:45
10-May-00	15.7	9.21	10.9	475	0.2	226	8.30	25	4	0.57	0.00	0.12	0.06	<0.05	2.55	160	90	12:30
24-May-00	12.1	8.07	17.2	428	0.2	204	8.56	12	7	0.36	0.01	0.06	0.03	<0.05	1.59	80	10	13:45
6-Jun-00	10.7	8.28	16.0	463	0.2	223	8.41	24	8	0.58	0.00	0.10	0.04	<0.05	1.69	210	100	12:30
21-Jun-00	11.0	9.34	15.5	476	0.2	228	7.99	116	19	0.82	0.01	0.23	0.17	<0.05	2.93	2200	200	12:30
11-Jul-00	9.7	9.22	17.8	469	0.2	224	8.24	25	10	0.46	0.00	0.16	0.09	<0.05	1.13	300	30	13:45
31-Jul-00	8.4	10.15	16.3	506	0.2	242	8.00	26	6	0.66	0.00	0.10	0.10	<0.05	<0.05	400	100	11:45

East Fork 2 EF2

Date	Q ft^3/s	DO mg/L	Temp °C	Cond µS	Salinity ppt	TDS mg/L	pH	TSS mg/L	TVSS mg/L	NO3 mg/L	NO2 mg/L	Total P mg/L	Ortho P mg/L	NH3 mg/L	TKN mg/L	Fecal cfu	E. Coli cfu	Time
20-Jul-99	27.0	9.16	10.9	177	0.2	177	7.82	5	3	0.47	<0.003	0.01	0.01	<0.05	1.91	40	<10	12:00
5-Aug-99	28.5	9.25	10.5	372	0.2	177	7.61	2	<1	0.49	<0.003	0.04	0.03	<0.05	1.07	<10	<10	11:00
19-Aug-99	25.6	9.37	10.4	392	0.2	186	7.81	4	1	0.37	<0.003	0.01	0.01	<0.05	0.92	<10	<10	12:30
2-Sep-99	27.7	9.36	10.4	394	0.2	187	7.72	<1	<1	0.47	<0.003	0.06	0.05	<0.05	<0.05	<10	<10	12:45
16-Sep-99	30.2	9.32	10.4	392	0.2	186	7.82	2	<1	0.92	<0.003	0.05	0.05	<0.05	0.85	<10	<10	12:30
6-Oct-99	28.0	9.39	10.3	397	0.2	188	7.92	<1	<1	<0.06	<0.003	0.01	0.01	<0.05	<0.05	<10	<10	13:30
18-Oct-99	29.3	9.30	10.2	395	0.2	187	7.67	3	2	0.51	<0.003	0.04	0.04	<0.05	0.47	<10	<10	14:15
9-Nov-99	27.0	9.29	10.2	402	0.2	301	7.99	2	2	0.51	<0.003	0.02	0.02	0.07	0.56	<1	<1	13:30
14-Dec-99	25.4	9.34	10.0	407	0.2	190	7.99	3	<1	0.46	<0.003	0.02	0.01	0.10	1.24	<10	<10	13:45
18-Jan-00	24.0	9.24	10.1	410	0.2	192	8.06	<1	<1	0.57	<0.003	0.05	<0.005	0.06	0.47	10	<10	14:30
7-Feb-00	24.0	9.23	10.2	401	0.2	189	n/a	<1	<1	0.37	<0.003	0.01	0.01	0.08	0.87	<10	<10	14:30
22-Feb-00	24.2	9.37	10.2	403	0.2	190	n/a	<1	<1	0.47	<0.003	0.05	0.05	0.07	0.69	<10	<10	13:45
13-Mar-00	21.1	9.28	10.4	397	0.2	188	7.81	2	1	0.45	<0.003	0.04	0.04	<0.05	1.53	<10	<10	13:15
27-Mar-00	21.1	9.22	10.4	392	0.2	186	7.65	<1	<1	0.41	<0.003	0.06	0.06	<0.05	0.76	<10	<10	14:00
10-Apr-00	22.3	9.18	10.5	395	0.2	188	7.46	<1	<1	0.42	<0.003	<0.01	<0.005	<0.05	1.47	<10	<10	12:30
25-Apr-00	21.7	9.24	10.4	187	0.2	393	7.63	<1	<1	0.48	<0.003	0.06	0.03	<0.05	0.76	10	<10	14:00
10-May-00	22.3	9.23	10.3	399	0.2	189	7.47	<1	<1	0.84	<0.003	0.04	0.03	<0.05	0.09	<10	<10	13:00
24-May-00	22.5	9.25	10.5	386	0.2	184	7.64	<1	<1	0.44	0.004	0.10	0.08	<0.05	0.56	20	<10	14:30
6-Jun-00	20.2	9.17	10.7	387	0.2	184	7.41	<1	<1	0.59	<0.003	0.08	0.07	<0.05	0.61	40	20	13:30
21-Jun-00	21.9	9.73	10.9	367	0.2	177	7.41	2	<1	0.50	<0.003	0.15	0.15	<0.05	0.59	20	10	15:30
11-Jul-00	21.4	9.50	10.7	388	0.2	186	7.46	<1	<1	0.37	<0.003	0.12	0.09	<0.05	0.08	40	20	16:50
31-Jul-00	22.9	9.50	10.8	383	0.2	182	7.45	<1	<1	0.39	<0.003	0.06	0.05	<0.05	<0.05	10	10	12:30